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(54) **Stub axle with air passage**

(57) The stub axle16 has an inflation passage by which a tyre on a wheel mounted on a hub 24 rotatable on the stub axle can be supplied with inflating air. The inflation passage comprises an annular chamber 48 defined in part by the wall of an axial passage 26 through the stub axle and containing a drive shaft 28. The annular chamber 48 is also defined in part by an annular plug member 50 secured in an enlarged portion 40 of the axial passage 26. After the stub axle has been welded to an axle casing 10, an inlet 46 to the annular chamber 48 can be provided at any desired orientation. Air is supplied via inlet 46 to chamber 48 and thence via a longitudinal passage 52 and a radial passage 54 to a rotary seal 56 (eg a pair of lip seals) from which it passes via a passage 58 in the rotatable hub 24 to the tyre.

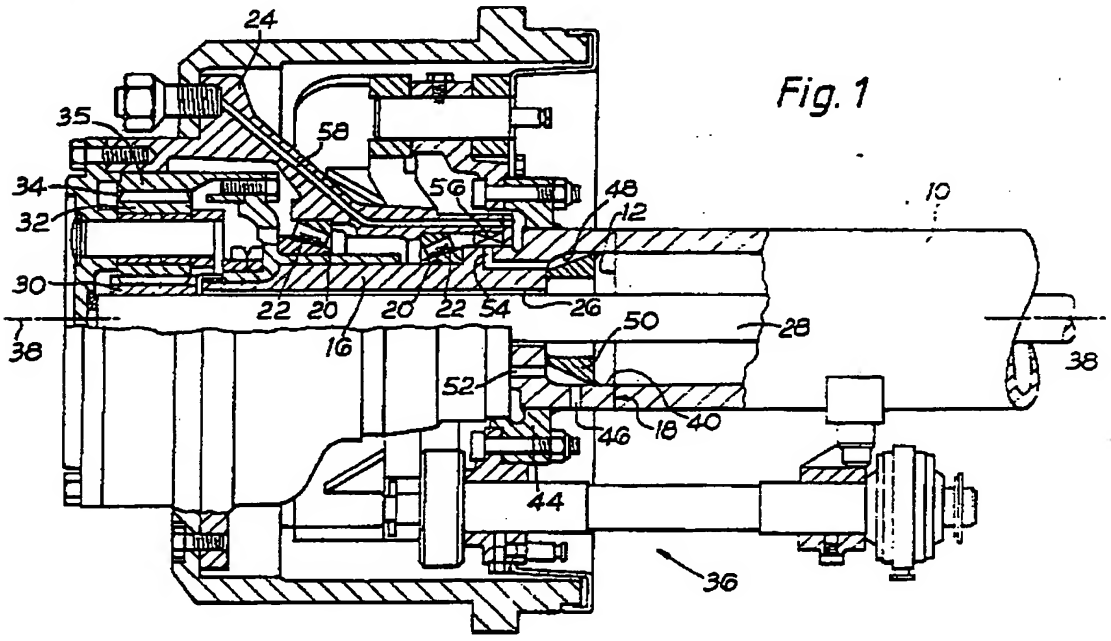

Fig. 1

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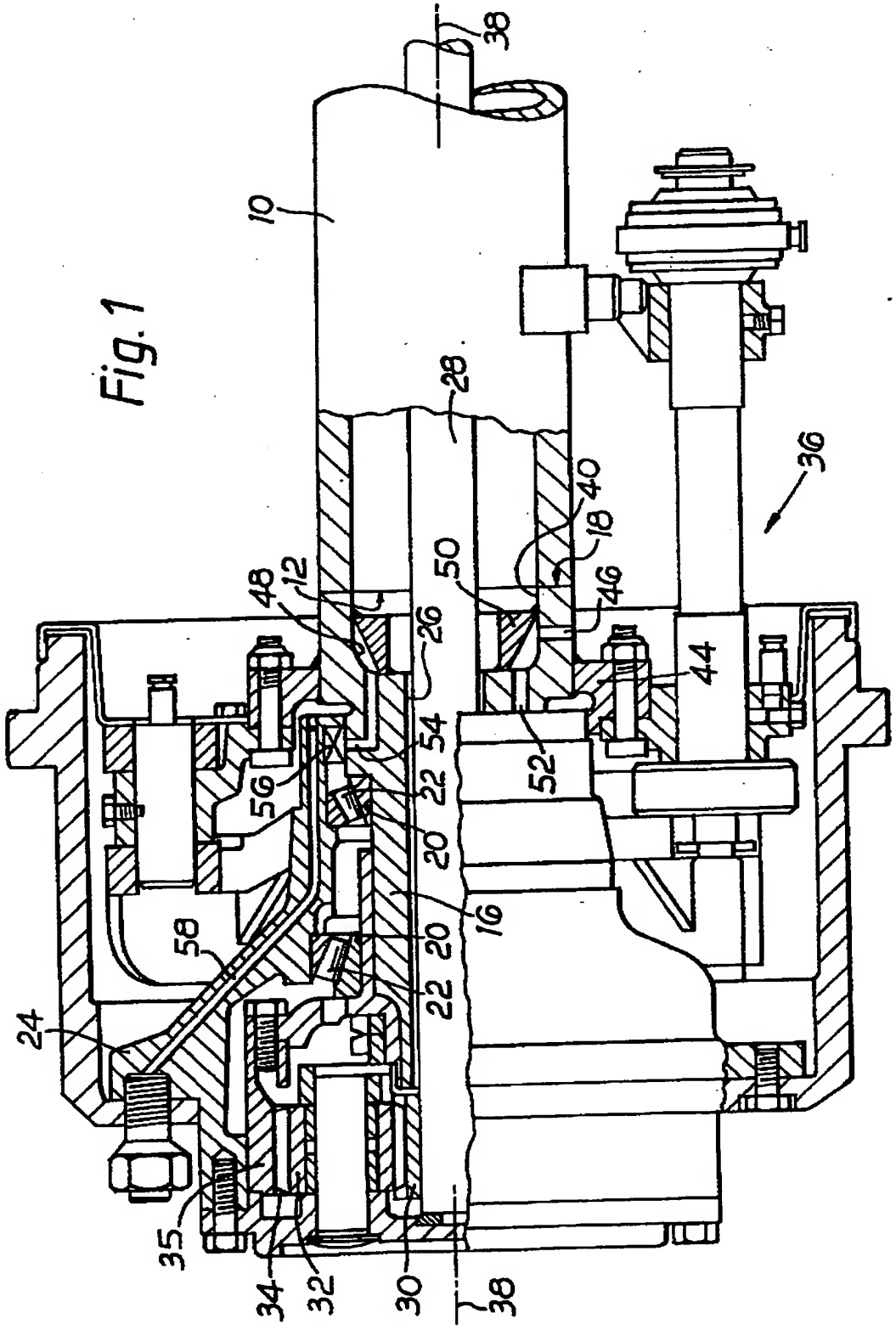
Fig. 1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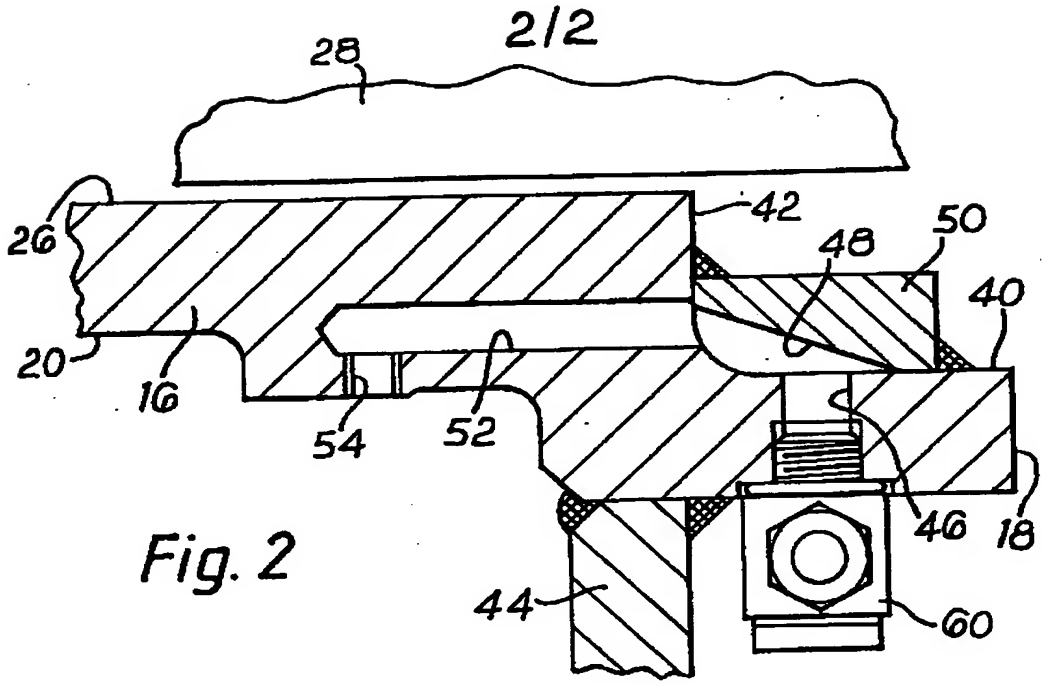
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Fig. 2

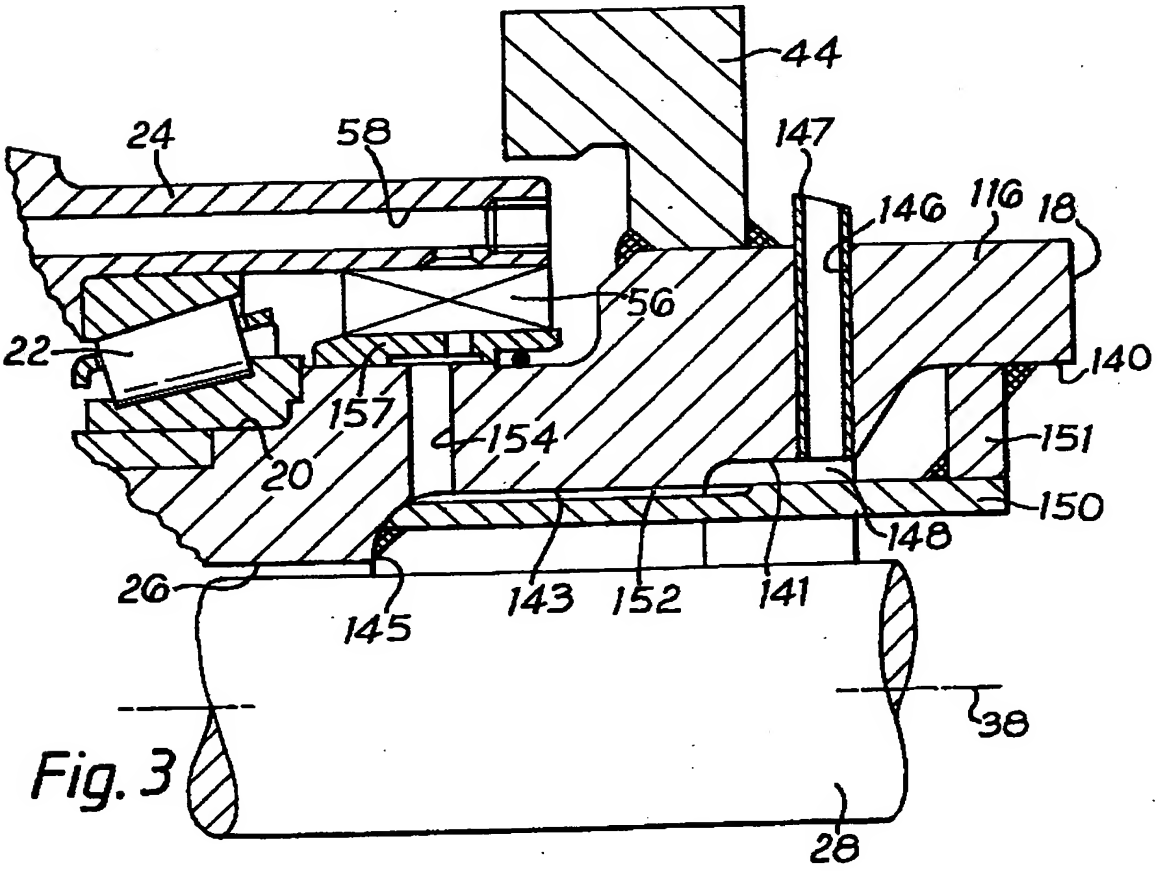
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Fig. 3

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STUB AXLE

This invention is concerned with a stub axle and a method of providing a vehicle axle with a stub axle having a passage therethrough by which inflation air can be supplied to or removed from the tyre of a wheel mounted on a hub mounted for rotation on the stub axle.

A number of methods are known for providing a vehicle with "central tyre inflation" systems in which inflation air from a fixed source on the vehicle can be supplied to a tyre of a rotating wheel of the vehicle. This gives the facility for increasing or decreasing the air pressure in the tyres of a vehicle in accordance with the terrain over which the vehicle is passing. Central tyre inflation has been used primarily on military vehicles to decrease the air pressure when passing over soft terrain and increase the air pressure when passing over hard terrain. The air pressure can be altered by an occupant of the vehicle without leaving the vehicle which may be important under combat conditions.

In a central tyre inflation system, it is necessary to provide a connection between the non-rotating air source on the vehicle and the rotating wheel. One method of providing this connection, where the wheel hub is rotating on a stub axle, is to provide an air passage through the non-rotating stub axle to an outlet into the hub of the wheel or into the interior of the wheel itself. Although such a passage can be formed before the stub axle is secured to the axle casing of the vehicle's axle, the orientation of an inlet to said passage is critical in many cases because of the restricted access

to the stub axle available in the area at which the stub axle is secured to the axle casing. Since the stub axle has radial symmetry and is generally secured by welding to the axle casing, e.g. by friction welding, the orientation of the stub axle relative to the casing is unpredictable so that the orientation of the inlet to the aforementioned air passage is also unpredictable and may not fall in an area to which access can be readily achieved. This problem has previously been recognised and a solution has been proposed in US Patent Specification No. 4,492,019. This solution involves providing an annular collar on the outside of the stub axle. The collar defines an annular chamber connected by a radial passage in the stub axle to the remainder of the air passage. After the stub axle has been welded to the axle casing, an inlet to the air passage is drilled at the desired orientation through the collar into the annular chamber. This solution is, however, expensive as it involves the provision of a collar making airtight seals with the exterior surface of the stub axle and requires additional space to be available for the collar.

It is an object of the present invention to provide a stub axle and a method of providing an axle with a stub axle having a passage therethrough by which inflation air can be supplied to or removed from the tyre of a wheel mounted on a hub mounted for rotation on the stub axle in which the aforementioned orientation problem is solved without the use of an external collar on the stub axle.

The invention provides a stub axle having at one end an attachment surface for welding to an axle casing, the stub axle defining two bearing-supporting exterior surface portions arranged to support bearings on which a

hub can rotate, and an axial passage extending through the stub axle and arranged to receive a drive shaft connected to the hub so that rotation of the drive shaft causes rotation of said hub, the stub axle also defining an inflation passage by which, when the inflation passage is provided with an inlet, air can be supplied to the tyre of a wheel mounted on the hub, the inflation passage comprising an annular portion defined by the wall of said axial passage and an annular plug member secured in an enlarged portion of said axial passage adjacent said attachment surface and in sealing engagement with the wall of said axial passage, a longitudinally-extending first passage portion communicating with said annular chamber, and a radially- extending second passage portion communicating with said first passage portion and the exterior surface of the stub axle between or adjacent to the bearing-supporting surface portions.

The invention also provides a method of providing a vehicle axle with a stub axle having a passage therethrough by which inflation air can be supplied to or removed from the tyre of a wheel mounted on a hub mounted for rotation on the stub axle, the stub axle defining two bearing-supporting exterior surface portions arranged to support bearings on which the hub rotates, an attachment surface at one end arranged to be welded to an axle casing, and an axial passage extending through the stub axle and arranged to receive a drive shaft connected to the hub so that rotation of the drive shaft causes rotation of said hub, the method comprising:

providing said axial passage with an enlarged portion adjacent to said attachment surface;

forming a first air passage portion extending longitudinally in the stub axle;

forming a second air passage portion extending radially in the stub axle from the exterior surface thereof between or adjacent to the bearing-supporting surface portions thereof, the second air passage portion extending to a communicating juncture with said first air passage portion;

securing an annular plug member in the enlarged portion of said axial passage so that the plug member makes sealing engagement with the wall of said enlarged passage portion and defines, with the wall of the axial passage, an annular chamber which is sealed except for a communication with said first air passage portion;

welding the attachment surface to the axle casing; and

forming an inlet air passage portion extending into said stub axle from the exterior surface thereof to a communicating juncture with said annular chamber.

In a stub axle according to the last preceding paragraph but one or in a method according to the last preceding paragraph, the inlet air passage portion is formed after the stub axle has been welded to the axle casing and can, therefore, be arranged at the desired orientation relative to the stub axle and this advantage is achieved without the use of a collar on the exterior of the stub axle.

Advantageously, said first air passage portion may be defined by the wall of said axial passage and the exterior surface of a hollow cylindrical plug member which is telescopically received in said axial passage and sealingly engages the wall of the axial passage. This arrangement provides an annular first air passage portion into which, if desired, a plurality of second

air passages may be joined thereby giving increased air flow.

In another advantageous alternative, said first air passage portion may be formed, before insertion of said plug member into said axial passage, by boring or drilling from a radially-extending interior surface formed at the junction of the enlarged portion of the axial passage with the remainder of the axial passage.

There now follow detailed descriptions, to be read with reference to the accompanying drawings, of two stub axles and two methods of providing a vehicle axle with a stub axle which are illustrative of the invention. It is to be understood that the illustrative stub axles and methods have been selected for description by way of example and not of limitation of the invention.

In the drawings:

Figure 1 is a side elevational view, partly in section, of an end portion of a vehicle axle which has been provided with a first illustrative stub axle by a first illustrative method;

Figure 2 is a cross-sectional view, on a larger scale than Figure 1, through a portion of the first stub axle provided by the first illustrative method; and

Figure 3 is a cross-sectional view through a portion of a second stub axle provided by the second illustrative method.

The vehicle axle shown in Figure 1 is a non-steering drive axle and comprises an axle casing 10 which is

arranged to be mounted on a vehicle in conventional manner. The portion of the casing 10 which is visible in Figure 1 is in the form of a hollow cylinder ending with an annular surface 12. The vehicle axle also comprises the first illustrative stub axle 16 which has at one end thereof an annular attachment surface 18 thereof welded to the surface 12 to secure the stub axle 16 to the casing 10.

The stub axle 16 defines two bearing-supporting exterior surface portions 20 arranged to support bearings 22 of the vehicle axle on which a hub 24 can rotate. An axial passage 26 extends through the stub axle 16 and is arranged to receive a drive shaft 28 connected to the hub 24 by an arrangement of gears so that rotation of the drive shaft 28 causes rotation of the hub 24. The arrangement of gears comprises a sun gear 30 secured to the drive shaft 28 to rotate therewith, three planet gears 32 mounted on the hub 24 to turn about their own axes and meshed with the sun gear 30, and an annular gear 34 mounted on a holder 35 which is fixedly-mounted on the stub axle 16 and surrounds and meshes with the planet gears 32. The gear arrangement 30, 32 and 34 provides, in conventional manner, a gear ratio between the drive shaft 28 and the hub 24. The vehicle axle also comprises a brake mechanism 36.

The first illustrative stub axle 16 is shown in Figures 1 and 2, Figure 2 showing only a rearward portion of the stub axle adjacent the attachment surface 18 thereof. It will be understood that the stub axle 16 has radial symmetry (apart from the air passage to be described) about the axis 38 about which the shaft 28 rotates. Adjacent to the attachment surface 18 thereof, the axial passage 26 has an enlarged portion 40 so that a

radially extending interior surface 42 of the stub axle 16 is provided between said enlarged portion 40 and the remainder of said axial passage 26. A conventional brake flange 44 is welded to an exterior surface of the stub axle 16 to support the brake mechanism 36.

The stub axle 16 also defines an inflation passage therethrough by which inflation air can be supplied to or removed, if dsesired, from the tyre (not shown) of a wheel (not shown) mounted on the hub. This passage comprises an inlet air passage portion 46 which extends into said stub axle 16 from the exterior surface thereof to a communicating juncture with an annular chamber 48 formed within the portion 40 of the axial passage 26. The annular chamber 48 is defined by the surface of said axial passage 26 in the enlarged portion 40 thereof, by the surface 42, and by an annular plug member 50 which is secured by welding into the enlarged portion 40 of the axial passage 26 so that the plug member makes sealing engagement with the wall of the enlarged passage portion 40.

The shape of the plug member 50 in cross-section appears from Figure 2. It is generally wedge-shaped having a narrow end surface welded to the surface 42 and a wide end surface welded to the wall of the enlarged portion 40 of the passage 26. An inclined surface between the narrow and wide end surfaces bounds the annular chamber 48. The annular chamber 48 provides an annular portion of the inflation passage of the stub axle 16.

The inflation passage also comprises a longitudinally-extending first passage portion 52 communicating with said annular chamber 48. The passage

portion 52 is formed by a bore which commences at the surface 42. The inflation passage also comprises a radially-extending second passage portion 54 communicating with the first passage portion 52 and the exterior surface of the stub axle 16 adjacent to bearing-supporting surface portions 20. In the stub axle 16, the passage portion 54 is adjacent the further inboard of the surface portions 20 but, in modifications, may be between the surface portions 20. In order to increase the air available for air flow, the passage portions 52 and 54 may be duplicated (as shown in Figure 1), or triplicated, or quadrupled.

The passage portions 54 enter a rotary seal 56 of conventional construction (for example, a pair of lip seals (not shown) may bear on the surface of the stub axle 16). A passage 58 formed in the hub 24 conducts air from the rotary seal 56 for connection to the tyre of a wheel mounted on the hub 24.

In the illustrative method of providing a vehicle axle with the first illustrative stub axle 16, the stub axle with the axial passage 26 including the enlarged portion 40 of the axial passage 26 is first provided by conventional casting and machining processes. Then the first air passage portion 52 and the second air passage portion 54 are formed together with the annular chamber 48. First, the passage portions 52 and 54 are formed by drilling or boring. Then, the annular plug member 50 is introduced into the axial passage 26. The plug member 50 is then welded to the surface 42 and to the surface of the enlarged portion 40 of the axial passage 26. Thus, the annular chamber 48 is created which communicates with the passage portions 52 and 54.

Next, in the illustrative method of providing a vehicle axle, the surface 18 of the stub axle 16 is friction welded to the surface 12 of the casing 10. The passage portion 46 is then formed by a bore extending radially from the exterior surface of the stub axle to the annular chamber 48, the bore being formed at the desired orientation for connection of a source of air under pressure to the inflation passage through the stub axle 16. A fitment 60 is then fixed in the bore to form the connection to a source of air under pressure mounted on the vehicle.

The second illustrative stub shaft 116 is shown in Figure 3 and differs from the first illustrative stub shaft 16 only in the formation of the inflation air passage thereof. The stub shaft 116 forms part of a vehicle axle in identical fashion to the stub axle 16 and identical reference numerals are used for parts of the stub axle 116 which are identical to those of the stub axle 16 and identical reference numerals are also used for parts of the remainder of the axle.

The stub axle 116 differs from the stub axle 16 in that the enlarged portion of the axial passage 26 thereof is formed as a series of stepped portions of decreasing diameter. The portion 140 of largest diameter opens at one end through the attachment surface 18 and, at the other end, tapers into a portion 141 of reduced diameter. The portion 141 communicates with a portion 143 of reduced diameter which is joined by a tapering surface 145 to the remainder of the axial passage 26.

The inflation passage of the stub axle 116 comprises an inlet air passage portion, formed by a bore 146 which extends radially into the stub axle 116 and has a tube

147 fixed therein. The bore 146 makes a communicating juncture with an annular chamber 148 which provides an annular portion of the inflation passage. The chamber 148 is formed within the portions 140 and 141 of the axial passage 26 and is defined by the surfaces thereof and by an annular plug member 150 which is secured by welding in the axial passage 26.

The annular plug member 150 is in the form of a cylinder with an external flange 151 at one end thereof. The plug member 150 is telescopically received in the enlarged portions of the axial passage 26 and one end thereof is welded to the surface 145 and the flange 151 is welded to the surface of the passage portion 140. The plug member 150 thus makes sealing engagement with the wall of the enlarged portion 140, 141, 143 of the passage 26.

The plug member 150, where it passes through the passage portion 143 and enters the passage portion 141, has a reduced external diameter so that an annular first passage portion 152, providing a longitudinally-extending portion of the inflation passage, is formed between the plug member 150 and the wall of the passage portion 143. The inflation passage also comprises four radially-extending second passage portions 154 (only one shown in Figure 3) communicating with the first passage portion 152 and with the exterior surface of the stub axle 116. The passage portions 154 enter the rotary seal 56 through a wear piece 157 mounted on the exterior of the stub axle 116.

In the illustrative method of providing a vehicle axle comprising the stub axle 116, the passage portions 154 are first formed by boring or drilling and the plug

member 150 is then welded in position in the enlarged portion 140, 141, 143 of the axial passage 26. The stub axle 116 is then secured to the casing 10 by welding the surfaces 12 and 18 together. Then the passage portion 146 is formed in the desired orientation by boring from the exterior surface of the stub axle 116 to the annular chamber 148 at the desired orientation.

CLAIMS

1. A stub axle having at one end an attachment surface for welding to an axle casing, the stub axle defining two bearing-supporting exterior surface portions arranged to support bearings on which a hub can rotate, and an axial passage extending through the stub axle and arranged to receive a drive shaft connected to the hub so that rotation of the drive shaft causes rotation of said hub, the stub axle also defining an inflation passage by which, when the inflation passage is provided with an inlet, air can be supplied to the tyre of a wheel mounted on the hub, the inflation passage comprising an annular portion defined by the wall of said axial passage and an annular plug member secured in an enlarged portion of said axial passage adjacent said attachment surface and in sealing engagement with the wall of said axial passage, a longitudinally-extending first passage portion communicating with said annular chamber, and a radially-extending second passage portion communicating with said first passage portion and the exterior surface of the stub axle between or adjacent to the bearing-supporting surface portions.

2. A method of providing a vehicle axle with a stub axle having a passage therethrough by which inflation air can be supplied to or removed from the tyre of a wheel mounted on a hub mounted for rotation on the stub axle, the stub axle defining two bearing-supporting exterior surface portions arranged to support bearings on which the hub rotates, an attachment surface at one end arranged to be welded to an axle casing, and an axial passage extending through the stub axle and arranged to receive a drive shaft connected to the hub so that

rotation of the drive shaft causes rotation of said hub, the method comprising:

providing said axial passage with an enlarged portion adjacent to said attachment surface;

forming a first air passage portion extending longitudinally in the stub axle;

forming a second air passage portion extending radially in the stub axle from the exterior surface thereof between or adjacent to the bearing-supporting surface portions thereof, the second air passage portion extending to a communicating juncture with said first air passage portion;

securing an annular plug member in the enlarged portion of said axial passage so that the plug member makes sealing engagement with the wall of said enlarged passage portion and defines, with the wall of the axial passage, an annular chamber which is sealed except for a communication with said first air passage portion;

welding the attachment surface to the axle casing; and

forming an inlet air passage portion extending into said stub axle from the exterior surface thereof to a communicating juncture with said annular chamber.

3. A method according to Claim 2, wherein said first air passage portion is defined by the wall of said axial passage and the exterior surface of a hollow cylindrical plug member which is telescopically received in said axial passage and sealingly engages the wall of the axial passage.

4. A method according to Claim 2, wherein said first air passage portion is formed, before the insertion of said plug member into said axial passage, by boring or drilling from a radially-extending interior surface formed at the junction of the enlarged portion of the axial passage with the remainder of the axial passage.

5. A stub axle substantially as hereinbefore described with reference to and as shown in:

i) Figures 1 and 2 of the accompanying drawings;

ii) Figure 3 of the accompanying drawings.

6. A method of providing a vehicle axle substantially as hereinbefore described with reference to:

i) Figures 1 and 2 of the accompanying drawings;

ii) Figure 3 of the accompanying drawings.

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